

DETAILED ACTION

1. Claims 7-12 and 14-20 are presented for examination, wherein claims 7-8, 11, 14, and 18-19 are currently amended. Claims 1-6 and 13 are cancelled.
2. The prior 35 U.S.C. § 103(a) rejection of claims 7-12 and 14-20 over Kodas et al (US 2003/0,108,664) is withdrawn as a result of the amendments to said claims.

Claim Rejections - 35 USC § 103

3. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.
4. Claims 7-12 and 14-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kodas et al (US 2003/0,108,664) in view of Ahlquist et al (US 6,015,652).
 - a. Regarding independent claim 7, Kodas teaches a method of fabricating electronic features (¶0003) such as UBM (¶0349), comprising step of: sintering (¶0061) conductive metal or metal alloy particles (¶0049, wherein the metal may include silver, palladium, gold, and platinum), where said low temperature processing is expected to form a conductive metal or metal alloy layer from said metal or metal alloy particles which performs one or more of mechanically, thermally, or electrically interconnecting the electrical component and the substrate (see *supra*) and wherein said metal or metal alloy, prior to said step of sintering, is present in the form of a paste (¶0039, teaching one embodiment is a conductive paste) which comprises a dispersant associated with the metal or metal alloy particles, said dispersant being present in sufficient quantity to reduce or prevent agglomeration of said metal or metal alloy particles (¶0132); and a binder having a temperature of volatilization below the sintering temperature of said

metal or metal alloy particles. (¶¶0128-29, including wax and PVA, which have a vaporization temperature below the sintering temperature of silver, as admitted by the applicants in ¶0027 of the instant specification).

While Kodas does not expressly teach the particle size being 500 nm or less, it teaches a plurality of nanoparticles with an average size of not greater than about 100 nm (¶0048), which is entirely within the instantly claimed range of 500 nm or less. As a result, it would have been obvious to a person of ordinary skill at the time of the invention to use particles with a particle size within the instantly claimed range of 500 nm or less, since Kodas teaches a range of particles that is entirely within the instantly claimed range.

Kodas teaches under bump metallization (¶0349, hereinafter “UBM”), but does not expressly teach the UBM is used to perform “at least one of mechanically, thermally or electrically bonding an electrical component to a substrate” and “positioned on contacts on the electrical component and the substrate and sandwiched therebetween.” However, Ahlquist teaches a method of manufacturing a flip chip device, wherein UBM is applied to one or both substrates to be joined (6:14-17) in order to mechanically and electrically connect (1:12-14) flip chips to a substrate (1:22-25). The UMB layer is necessary to wet the bonding sites to which the solder is applied, in order to successfully bond the flip chip to the substrate (2:20-25). Ahlquist further states that its teaching is open to applying any suitable of UBM material (4:51-54).

As a result, it would have been obvious to a person of ordinary skill at the time of the invention to mechanically bond a flip chip, an electrical component, to a silicon

substrate with UMB, as taught by Ahlquist using the UBM taught by Kodas, since Ahlquist teaches a UBM layer is necessary to successfully bond the flip chip to the substrate.

In the alternative, Ahlquist teaches an exemplary UBM composition, wherein Ahlquist expressly does not limit the UBM composition to the example provided (4:51-54), wherein Ahlquist expressly teaches a composition is added to provide a solder wettable and metallurgically sound interface (5:4-7), forming a mechanical and electrical bonding layer (5:21-24). As a result, it would have been obvious to a person of ordinary skill at the time of the invention to mechanically bond a flip chip, an electrical component, to a silicon substrate with UMB, as taught by Ahlquist using the UBM taught by Kodas, since Ahlquist teaches a UBM layer is added to form a mechanically and electrically bonding layer between a flip chip to a substrate.

b. Regarding claim 8, Kodas as modified teaches the method of claim 7, to fabricate UBM (¶0349), but does not expressly teach the UBM is used to perform “at least one of mechanically, thermally or electrically bonding an electrical component to a substrate” and “positioned on contacts on the electrical component and the substrate and sandwiched therebetween.” However, Ahlquist teaches UBM is formed into a thin layer between the solder bump and contact pads (3:53-55), which provides a wetting surface for successful bonding (2:20-25, which suggests mechanically bonding) and wherein the metal(s) in the UBM must be highly conductive (2:35-37, which suggests electrical bonding) between the flip chip and the substrate (1:12-14).

In the alternative, Ahlquist teaches an exemplary UBM composition, wherein Ahlquist expressly does not limit the UBM composition to the example provided (4:51-54), wherein Ahlquist expressly teaches a composition is added to provide a solder wettable and metallurgically sound interface (5:4-7), forming a mechanical and electrical bonding layer (5:21-24). As a result, it would have been obvious to a person of ordinary skill at the time of the invention to mechanically bond a flip chip, an electrical component, to a silicon substrate with UMB, as taught by Ahlquist using the UBM taught by Kodas, since Ahlquist teaches a UBM layer is added to form a mechanically and electrically bonding layer between a flip chip to a substrate.

- c. Regarding claim 9, Kodas as modified teaches the method of claim 8, wherein Kodas teaches the deposition may include screen printing. (¶0052).
- d. Regarding claim 10, Kodas as modified teaches the method of claim 7, wherein Kodas teaches the metal or metal alloy particle is about 100 nm or less (¶0048, which overlaps the instantly claimed range of 100 nm or less).
- e. Regarding claim 11, Kodas as modified teaches the method of claim 7, wherein Kodas teaches forming UBM (¶0349), wherein the step of “further comprising the step of holding the device and the substrate together during the step of sintering” would be expected since the weight of the device weighs down on the bump material and the substrate and is expected in order to keep a good bump connection between the device and substrate, since bump connections are used to transfer electric and thermal energy away from the device and also mechanically hold the chip onto the substrate.

- f. Regarding claim **12**, Kodas as modified teaches the method of claim 7, wherein Kodas teaches the metal or metal alloy is silver or silver alloy ¶0049).
- g. Regarding independent claim **14**, Kodas teaches a method of fabricating electronic features (¶003) such as UBM (¶0349) paste (¶0039, teaching one embodiment is a conductive paste), wherein the paste comprises (i) a plurality of conductive metal or metal alloy particles (¶0049, wherein the metal may include silver, palladium, gold, and platinum); (ii) dispersant associated with the metal or metal alloy particles, said dispersant being present in sufficient quantity to reduce or prevent agglomeration of said metal or metal alloy particles (¶0132); and (iii) a binder having a temperature of volatilization below the sintering temperature of said metal or metal alloy particles. (¶¶0128-29, including wax and PVA have a vaporization temperature below the sintering temperature of silver, as admitted by the applicants in ¶0027 of the instant specification); and heating the nanoparticles such that the polymers can decompose, enabling the nanoparticles to sinter together (¶0061, which suggests the temperature and time are sufficient to remove said binder and said dispersant), which in the UBM embodiment (¶0349) would be expected the sintered metal or metal alloy layer would perform “at least one of mechanically, thermally, or electrically connecting a device to a substrate.”

While Kodas does not expressly teach the particle size being 500 nm or less, it teaches a plurality of nanoparticles with an average size of not greater than about 100 nm (¶0048), which is entirely within the instantly claimed range of 500 nm or less. As a result, it would have been obvious to a person of ordinary skill at the time of the invention to use particles with a particle size within the instantly claimed range of 500

nm or less, since Kodas teaches a range of particles that is entirely within the instantly claimed range.

Kodas teaches UBM (¶0349), but does not expressly teach the UBM is used to perform “at least one of mechanically, thermally or electrically bonding an electrical component to a substrate” and “positioned on contacts on the electrical component and the substrate and sandwiched therebetween.” However, Ahlquist teaches a method of manufacturing a flip chip device, wherein UBM is applied to one or both substrates to be joined (6:14-17) in order to mechanically and electrically connect (1:12-14) flip chips to a substrate (1:22-25). The UMB layer is necessary to wet the bonding sites to which the solder is applied, in order to successfully bond the flip chip to the substrate (2:20-25). Ahlquist further states that its teaching is open to applying any suitable of UBM material (4:51-54).

As a result, it would have been obvious to a person of ordinary skill at the time of the invention to mechanically bond a flip chip, an electrical component, to a silicon substrate with UMB, as taught by Ahlquist using the UBM taught by Kodas, since Ahlquist teaches a UBM layer is necessary to successfully bond the flip chip to the substrate.

In the alternative, Ahlquist teaches an exemplary UBM composition, wherein Ahlquist expressly does not limit the UBM composition to the example provided (4:51-54), wherein Ahlquist expressly teaches a composition is added to provide a solder wettable and metallurgically sound interface (5:4-7), forming a mechanical and electrical bonding layer (5:21-24). As a result, it would have been obvious to a person of ordinary

skill at the time of the invention to mechanically bond a flip chip, an electrical component, to a silicon substrate with UMB, as taught by Ahlquist using the UBM taught by Kodas, since Ahlquist teaches a UBM layer is added to form a mechanically and electrically bonding layer between a flip chip to a substrate.

h. Regarding claim 15, Kodas as modified teaches the method of claim 14, wherein Kodas teaches the metal or metal alloy is silver or silver alloy (§0049).

i. Regarding claim 16, Kodas as modified teaches the method of claim 14, wherein Kodas teaches the metal or metal alloy particle is about 100 nm or less (§0048, which overlaps the instantly claimed range of 100 nm or less).

j. Regarding claim 17, Kodas as modified teaches the method of claim 14, wherein Kodas teaches the deposition may include screen printing. (§0052).

k. Regarding claim 18, Kodas as modified teaches the method of claim 14, wherein Kodas teaches heating the nanoparticles such that the polymers can decompose, enabling the nanoparticles to sinter together (§0061, by selecting a binder that decomposes at or below sintering temperature of the nanoparticles, the instantly claimed step of “selecting said binder in said paste based on a desired temperature of volatilization” is met).

l. Regarding claim 19, Kodas as modified teaches the method of claim 14, wherein Kodas teaches heating the nanoparticles such that the polymers can decompose, enabling the nanoparticles to sinter together (§0061, by selecting and decomposing a binder that decomposes at or below sintering temperature of the nanoparticles, the instantly claimed step of “isolating said metal or metal alloy particles with said binder until a preset

temperature during said heating step, wherein said preset temperature is determined based on said binder and a sintering temperature for said metal or metal alloy particles” is met).

m. Regarding claim 20, Kodas as modified teaches the method of claim 19, wherein Kodas teaches heating the nanoparticles such that the polymers can decompose, enabling the nanoparticles to sinter together (§0061, by sintering at a predetermined temperature the preset temperature is “is the same as or slightly below a sintering temperature for said metal or metal alloy particles”).

5. In the alternative in the event Kodas is not interpreted to meet the claimed holding step, claim 11 is also rejected under 35 U.S.C. 103(a) as being unpatentable over Kodas et al (US 2003/0,108,664) in view of Ahlquist et al (US 6,015,652) with evidence from Estes et al (US 6,189,208).

Regarding claim 11, Kodas as modified teaches the method of claim 7 as provided *supra*, which includes forming UBM (§0349), but does not expressly teach the step of “holding the device and the substrate together during the step of sintering.”

Estes teaches a method of connecting a device to a substrate via bump connection (1:21-26) and teaches the importance of minimizing the final bump height for the best electrical, thermal, and mechanical properties. (2:28-30). As a result, it would have been obvious to a person of ordinary skill at the time of the invention to hold the device and substrate together during sintering in the invention of Kodas, since Estes teaches the importance of minimizing the final bump height for mechanical, thermal, and electrical properties.

6. Claims 7, 10, 12 and 14-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hata et al (JP 2002-334618).

a. Regarding claim 7, Hata teaches a method of forming a conductive metal film (¶0001) that may be used as an interconnect mechanically, thermally or electrically bonding an electrical component to a substrate (¶0002, plating for terminals and electrical contacts and ¶0006, electrical contact), comprising the step of: (a) sintering conductive metal or metal alloy particles (¶0037, silver, copper, and platinum) with a mean particle size of 1-100 nm (¶0012, overlapping the instantly claimed range of "500 nm or less"), said sintering step forming a conductive metal or metal alloy layer from said metal or metal alloy particles which electrically interconnecting the electrical component and the substrate (¶0002), wherein the conductive metal is silver, gold, palladium, or platinum (¶¶ 0007 and 37), and wherein said metal or metal alloy, prior to said step of sintering, is present in the form of a paste (¶0021) which comprises a dispersant associated with the metal or metal alloy particles (¶¶ 0021 and 23-26).

Hata teaches using an organic binder (¶0041) and using terpineol in the dispersion liquid (¶0046) and sintering at not more than 300°C (¶0026), but does not expressly teach the "binder having a temperature of volatilization below the sintering temperature of said metal or metal alloy particles." However, the sintering range overlaps the instant sintering range (300°C, see e.g. ¶0015) and the instant specification also teaches terpineol as a binding agent (¶0027). As a result, the terpineol in Hata meets said limitation.

Hata teaches the paste includes a "dispersion liquid" (¶0013), and further teaches that flocculation negatively impacts the dense filling state with high reproducibility

(¶0023), but does not expressly teach “said dispersant being present in sufficient quantity to reduce or prevent agglomeration of said metal or metal alloy particles.” However, since Hata teaches the presence of dispersant, which prevents flocculation, and that flocculation negatively impacts the reproducibility of dense filling, a person or ordinary skill in the art at the time of the invention would understand that the amount of the dispersant is a result effective variable and the instantly claimed amount does not patentably distinguish the instant invention from Hata. See MPEP § 2144.05.

Hata teaches “carrying electronic parts on a substrate using the conductive metal coat for plating” (¶0001), and further teaches in a keyboard circuit that the plating is on an electric contact (¶0006), which would suggest to a person of ordinary skill in the art at the time of the invention that the conductive metal would be connected to the contacts of the electronic part, and further that the conductive metal is sandwiched between the electrical component and the substrate.

- b. Regarding claim 10, Hata teaches the method of claim 7, wherein said metal or metal alloy particles are of a size of 1-100 nm (¶0012, overlapping the instantly claimed “100 nm or less”).
- c. Regarding claim 12, Hata teaches the method of claim 7, wherein said metal or metal alloy is silver or silver alloy (¶0037).
- d. Regarding claim 14, Hata teaches a method of forming a conductive metal film (¶0001) that may be used to bond an electrical component to a substrate (¶0002, plating for terminals and electrical contacts and ¶0006, electrical contact), comprising: (a)

positioning a paste between contacts of said substrate and said electrical component (¶0002, wherein plating to bond an electrical component to a substrate satisfies “positioning a paste between contacts of said substrate and said electrical component”), the paste (¶0021) comprising (i) conductive metal or metal alloy particles (¶0037, silver, copper, and platinum) with a mean particle size of 1-100 nm (¶0012, overlapping the instantly claimed range of “500 nm or less”), and (b) heating said paste to a temperature and for a time sufficient to remove said binder and said dispersant (¶0050), and to sinter metal particles of said metal or metal alloy powder together to form a conductive metal or metal alloy layer from said metal or metal alloy particles (¶0050), which performs at least one of mechanically, thermally, or electrically interconnecting the electrical component and the substrate (¶0002, plating for terminals and electrical contacts and ¶0006, electrical contact).

Hata teaches the paste includes a “dispersion liquid” (¶0013), and further teaches that flocculation negatively impacts the dense filling state with high reproducibility (¶0023), but does not expressly teach “said dispersant being present in sufficient quantity to reduce or prevent agglomeration of said metal or metal alloy particles.” However, since Hata teaches the presence of dispersant, which prevents flocculation, and that flocculation negatively impacts the reproducibility of dense filling, a person or ordinary skill in the art at the time of the invention would understand that the amount of the dispersant is a result effective variable and the instantly claimed amount does not patentably distinguish the instant invention from Hata. See MPEP § 2144.05.

Hata teaches using an organic binder (§0041) and using terpineol in the dispersion liquid (§0046) and sintering at not more than 300°C (§0026), but does not expressly teach the “binder having a temperature of volatilization below the sintering temperature of said metal or metal alloy particles.” However, the sintering range overlaps the instant sintering range (300°C, see e.g. §0015) and the instant specification also teaches terpineol as a binding agent (§0027). As a result, the terpineol in Hata meets said limitation.

- e. Regarding claim 15, Hata teaches the method of claim 14, wherein said metal or metal alloy is silver or silver alloy (§0037).
- f. Regarding claim 16, Hata teaches the method of claim 14, wherein the mean particle diameter is 2-10 nm (overlapping the instantly claimed range of 100 nm or less).
- g. Regarding claim 17, Hata teaches the method of claim 14, wherein the positioning step is by printing and screen-stenciling (§0049).
- h. Regarding claims **18-20**, Hata teaches the method of claim 14 and using an organic binder (§041) and using terpineol in the dispersion liquid (§0046) and sintering at not more than 300°C (§0026), but does not expressly teach “selecting said binder in said paste based on a desired temperature of volatilization;” “isolating said metal or metal alloy particles with said binder until a preset temperature during said heating step, wherein said preset temperature is determined based on said binder and a sintering temperature for said metal or metal alloy particles;” and “wherein said preset temperature is the same as or slightly below a sintering temperature for said metal or metal alloy particles.”

However, Hata teaches the paste includes terpineol and sintering at +210°C for 60 minutes, overlapping the instant sintering range (up to 300°C, see e.g. ¶0027) and the instant specification also teaches terpineol as a binding agent (¶0027). As a result, said limitations would be obvious in view of the disclosure of Hata.

Response to Arguments

6. Applicant's arguments filed March 11, 2011 have been fully considered but they are not persuasive. The applicants make the following arguments:

7. First the applicants allege that nowhere does the reference mention attachment between two articles. Instead, the applicants argue the purpose of Kodas is to form an electrically conductive feature on a recessed surface (Response to the Office action p.8).

In response, the examiner respectfully notes, as provided in the prior Office action, that Kodas teaches the art may be used for UBM.

Ahlquist teaches a method of manufacturing a flip chip device, wherein UBM is applied to one or both substrates to be joined (6:14-17) in order to mechanically and electrically connect (1:12-14) flip chips to a substrate (1:22-25). The UMB layer is necessary to wet the bonding sites to which the solder is applied, in order to successfully bond the flip chip to the substrate (2:20-25). Ahlquist further states that its teaching is open to applying any suitable of UBM material (4:51-54). As a result, it would have been obvious to a person of ordinary skill at the time of the invention to mechanically bond a flip chip, an electrical component, to a silicon substrate with UMB, as taught by Ahlquist using the UBM taught by Kodas, since Ahlquist teaches a UBM layer is necessary to successfully bond the flip chip to the substrate.

In addition, Ahlquist teaches an exemplary UBM composition, wherein Ahlquist expressly does not limit the UBM composition to the example provided (4:51-54), wherein Ahlquist expressly teaches a composition is added to provide a solder wettable and metallurgically sound interface (5:4-7), forming a mechanical and electrical bonding layer (5:21-24). As a result, it would have been obvious to a person of ordinary skill at the time of the invention to mechanically bond a flip chip, an electrical component, to a silicon substrate with UMB, as taught by Ahlquist using the UBM taught by Kodas, since Ahlquist teaches a UBM layer is added to form a mechanically and electrically bonding layer between a flip chip to a substrate.

8. Second, the applicants allege Kodas discloses that the viscosity of the precursor is not important, referring to ¶0039, and further allege Kodas does not intend to use their composition as a bonding agent.

In response, the examiner respectfully notes, as provided in the prior Office action, that the same paragraph cited by the applicants note that the Kodas patent expressly teaches the composition includes one “commonly referred to as pastes.” Kodas further discloses the composition may alternatively be formulated to have a low viscosity, such as not greater than about 1,000 centipoise. However, Kodas does not teach, as the applicants allege, “that the viscosity of the precursor material is not important” (Response to the Office action p.8).

9. Third, the applicants note that the examiner has not complied with the Office’s policy of compact prosecution.

In response, the examiner respectfully notes the record has provided the applicants an opportunity to further clarify though both the claims and the prosecution history what is and is not within the meets and hounds of the instant invention.

Furthermore, the Office will not issue a patent until it satisfies the statutory requirements of the 35 U.S. Code.

Conclusion

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to YOSHITOSHI TAKEUCHI whose telephone number is (571) 270-5828. The examiner can normally be reached on Monday-Thursday 9:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jessica L. Ward can be reached on 571-272-1223. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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